

# Stochastic joint optimization of wind generation and pumped-storage units in an electricity market

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## Abstract-

One of the main characteristics of wind power is the inherent variability and unpredictability of the generation source, even in the short-term. To cope with this drawback, hydro pumped-storage units have been proposed in the literature as a good complement to wind generation due to their ability to manage positive and negative energy imbalances over time. This paper investigates the combined optimization of a wind farm and a pumped-storage facility from the point of view of a generation company in a market environment. The optimization model is formulated as a two-stage stochastic programming problem with two random parameters: market prices and wind generation. The optimal bids for the day-ahead spot market are the "here and now" decisions while the optimal operation of the facilities are the recourse variables. A joint configuration is modeled and compared with an uncoordinated operation. A realistic example case is presented where the developed models are tested with satisfactory results.

**Index Terms-** Day-ahead electricity markets, energy storage, optimization, profit maximization, wind power

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